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Spring 1994

Circulation, Spring 1994

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The MPC Project

In the coastal/open ocean interface, there is a plethora of flow phenomena ranging from fronts, squirts, jets, streamers, etc. to intense mid-ocean cyclones and anticyclones. The space scales for these features range from 1 to 50 km while the time scales vary from hours to weeks. It is difficult for conventional circulation models to resolve such a wide range of scales. To overcome this difficulty, CCPO scientists, JOHN HOLDZKOM, CHET GROSCHE, and A. D. KIRWAN, JR., working with M. Zubair and Nadima Kauser of the Computer Science Department, have been developing an alternate approach. Instead of solving the hydrodynamic equations of motion and conservation of mass on a discrete geographic grid, these scientists solve the hydrodynamic equations at particles using information interpolated from the grid. The particle density is large enough to resolve the time and space scales of the phenomena of interest. Typical simulations might use over a million particles. The numerical procedure requires regular exchange of information between the particles and the geographic grid. To accomplish this, the scientists are using a very efficient computer network message-passing construct that allows selected nodes on a network to emulate a massively parallel computer (MPC). In addition to resolving the wide range of phenomenological flow scales in the coastal ocean, this approach has several other advantages. The number of nodes can be varied to suit the requirements of specific simulations. The code, which is being jointly developed on the CCPO and the Computer Science networks, can easily be transferred to MPCs at other sites when completed. This approach also allows users to take advantage of a network to speed up calculations. Perhaps even more important, users are able to take advantage of the extended memory in a network. In effect, the approach allows users to develop code inexpensively and conveniently in-house on an existing network and then transfer it to other users or massively parallel computers. When completed, the model will not replace conventional gridded models, however, it should prove to be very useful for studying the movement and dispersion of contaminants in the coastal waters. The efforts of the CCPO scientists are supported by the Office of Naval Research as a component of an Advanced Research Initiative on applications of MPCs.

Community Outreach

One of the goals of the Center is to interact with the community by providing educational outreach programs. On April 28, the Center hosted two members of the Girls Incorporated Center for Youth of Southwest Hampton Roads (formerly the Girls Club) in honor of "Take Our Daughters to Work Day," an event sponsored annually by the National Ms. Foundation to provide girls with exposure to careers in non-traditional fields. Girls Incorporated works in conjunction with local businesses and institutions to introduce young women to non-traditional professionals who serve as mentors. Some of the fields of interest for this year's event were educational administration, veterinary medicine, architectural design, and oceanography. EILEEN HOFMANN was chosen to share her experience in oceanography with Ashley Boone and Heather Davis, members of Girls Incorporated, as part of their "career experience." The program started with a luncheon for the girls and their mentors in Portsmouth. CATHY LASCARA attended as a representative of the field of oceanography and brought the girls to the Center for an afternoon tour, which consisted of meeting with faculty and students and getting acquainted with the work done at the Center. Ashley and Heather talked with LIZ SMITH about how satellites can measure sea surface temperature and why it is important. CAITLIN MULLEN introduced them to some remote sensing work that she is doing on the Gulf Stream. LINDA LAWSON discussed the role of mathematics in the physical sciences with the girls. YVETTE SPITZ showed them real-time data from the NOAA oceanographic and observational station at the Chesapeake Bay Bridge Tunnel. A video and slides about the Palmer LTER Antarctic expeditions were presented by Eileen and Cathy. Several students and staff also attended this fascinating presentation. Overall, the program was very positive for both the mentors and the girls. Ashley and Heather's enthusiasm about oceanography made it a rewarding experience for everyone involved.

Student Profiles

BRUCE LEE LIPPHARDT, JR. received his B.S. in oceanography from the U. S. Naval Academy in 1984. After

completing training in the Navy's Nuclear Power program, he served for three years as a division officer on board the USS Cincinnati. In March 1989, he was transferred to shore duty as an operational test director for submarine sonar systems. In the fall of 1990, he resigned his commission and accepted a National Defense Science and Engineering Graduate fellowship to pursue a Ph.D. in physical oceanography under A. D. Kirwan, Jr. Bruce's dissertation research involves the use of a feature model to study the kinematics of dipole rings. He is also interested in using Lagrangian data to evaluate numerical models and in understanding the dynamics of oceanic flow near the continental shelf break. His dissertation is entitled, "Investigation of Cross-Shelf Transport by Baroclinic Vortex Pairs in the Mid-Atlantic Bight Region." After graduation, Bruce intends to pursue a postdoctoral position, and would like to become a professor of physical oceanography.

ANDRY WILLIAM RATSIMANDRESY received his B.S. in physics from the University of Madagascar in 1989. In 1991, Andry came to the United States to start his M.S. program in physical oceanography under the direction of John Klinck. Andry is interested in processes occurring near inlets. During his study at CCPO, his research focuses on transport of larvae from the open ocean to the estuarine nurseries. His work is in collaboration with Francisco Werner from the University of North Carolina, Chapel Hill, North Carolina. Upon Andry's graduation from ODU, he plans to return to his native country, Madagascar, to continue his research in oceanography on the waters around Madagascar. Since the area around Madagascar is quite new for oceanographic research, Andry is hoping to work with scientists from other countries, such as South Africa and Mozambique and to continue his collaboration with researchers in the United States.

New Face at CCPO: Liz Smith

ELIZABETH (Liz) SMITH arrived at CCPO in November 1993 to begin work on a grant from the NASA Mission to Planet Earth Program to validate a new satellite-derived sea surface temperature (SST) data set. SST may be among the best known oceanic parameters, thanks to the advent of space-borne observing systems in the 60's and 70's. It is, however, essential to measure at sea those parameters which are deduced from satellites and make the appropriate comparisons. The goal of Liz's work is to provide a quantitative assessment of a newly processed SST data set, called the Pathfinder SST. The joint NASA/NOAA Pathfinder program will produce long time-series of remote-sensing data sets applicable to global change research prior to the availability of data from the EOS satellites. Liz will carry out an independent validation of global AVHRR SST fields and provide feedback to the algorithm development team at the University of Miami and to the data production team at the Jet Propulsion Laboratory (JPL). After receiving a B.S. in Marine Science in 1982 from the University of South Carolina, Liz spent two years assisting Dr. Ned Smith at the Harbor Branch Oceanographic Institution, characterizing South Florida's Indian River estuary. She was awarded a NASA Traineeship to pursue graduate studies and received an M.S. in Oceanography from Florida State University in 1987, as a student of Dr. Tony Sturges. Liz spent the last six years as a member of the technical staff at JPL in Pasadena, California. Primarily NASA-funded, JPL plays a major role in NASA's unmanned space and planetary research and exploration programs. Liz's position as project scientist for the NASA Ocean Data System and later, the EOSDIS Physical Oceanography Archive Center, afforded her the opportunity to learn about the use of satellites to study the ocean. Liz was the technical manager of the Pathfinder AVHRR SST production task at JPL, and she provided scientific and technical guidance to the users of Seasat, CZCS, and AVHRR data, as well as to system developers.

Computers: A Way of Life For CCPO

Daily life at CCPO revolves around computers, for better or worse. CCPO uses them to store and manipulate observations, to run and analyze numerical models, to write documents of various sorts (proposals, papers, technical reports, and so forth), and to communicate locally, regionally, and internationally. Under the direction of JOHN KLINCK, associate professor and vice director for Center computing at CCPO, there was a decision made at the early birth of the Center that everyone in the Center would have a workstation on their desk and that these computers would be linked by a network so that various resources, such as disk space and printers, would be shared. The workstation provides access to local mail and other sources of information. This focus on electronic communication reduces the amount of paper being used and provides an easy method for circulating information rapidly through mail, or more

slowly, through local bulletin boards (news). It also allows us access to the growing information provided by the global computer network. Another important use for the computer system is to provide Center researchers and students a means to make calculations which involve working with observations or numerical models. Several levels of computer power are provided, starting with the individual workstations which are Sun SPARC Stations that run the UNIX operating system. The capacity of these computers satisfies the majority of users in the Center. At any one time, about 10 percent of the computer users need more computer power, which is provided by a Silicon Graphics 4D/310, a CDC 4330, and an IBM RS 6000/590. If greater performance is needed, then the University connection to the Internet provides access to any number of supercomputer centers around the world where the largest computers are available. The Center computer system also stores considerable data about the earth and its oceans. Much of this information is on CD-ROM, which are becoming a popular way for volumes of data to be distributed by various research institutes and government agencies. The Center has a few dozen disks, each storing up to 650 megabytes, with more arriving all the time (a dozen or more per year). Other data at the center is on tapes that have been obtained by individuals from other researchers of various data storage agencies. Finally, there is a steady stream of new information coming into the Center in the form of observations in the Chesapeake Bay and ocean surface temperature observations from satellite off the area of Virginia and North Carolina. We are now working on a graceful way to catalog all of this information to make it more readily available.

CCPO Represented at EGS Conference

The XIX General Assembly of the European Geophysical Society (EGS) was held at the University of Grenoble, Grenoble, France, April 25--29, 1994. The scientific program included about 100 sessions encompassing Solid Earth Geophysics, Oceans Atmosphere, Solar-Terrestrial Sciences, Planetary Solar System Sciences, Hydrology, and Nonlinear Processes in Geophysics, as well as Natural Hazards. More than 3,000 scientists from Europe and North America participated in the meeting. Six papers by CCPO scientists were presented at the Assembly. In addition, A. D. KIRWAN, JR., of CCPO, was co-convenor of the session, "Chaos Versus Stochasticity in Geophysics." Below is a list of those presentations by CCPO researchers and students:

J. J. HOLDZKOM II and A. D. KIRWAN, JR., "Dynamical Systems Aspects of a Nonlinear Hydrodynamic Lens Model."

S. B. Hooker, of NASA/Goddard Space Flight Center, Greenbelt, MD; J. W. Brown, of RSMAS, Miami, FL; A. D. KIRWAN, JR.; and R. P. Mied and G. J. Lindemann, both of the Naval Research Laboratory, Washington, DC, "Forecasting the Evolution of a Warm Core Ring."

A. D. KIRWAN, JR., B. L. LIPPHARDT, JR. and R. P. Mied of the Naval Research Laboratory, Washington, DC, "Baroclinic Rotating Modons: Exact Solutions to the Nonlinear Potential Vorticity Equations."

A. D. KIRWAN, JR., C. E. GROSCH, J. J. HOLDZKOM II, and N. Kausar and M. Zubair, both of the Department of Computer Science, "Particle in Cell Simulations on MPPS: Very Large Dynamical Systems."

M. TONER and A. D. KIRWAN, JR., "Topology of a Chaotic Two-Dimensional Climate Model." M. TONER and A. D. KIRWAN, JR., "Parametric Time Dependence and Bifurcation Analysis of a Climate Model."

Just the facts...

Graduates

M.S.: ANDRY RATSIMANDRESY, May 1994, Advisor: John Klinck.

Grants/Contracts Awarded

L. P. ATKINSON, G. T. CSANADY, J. L. MILLER, and A. VALLE-LEVINSON, "Effects of Chesapeake Bay Bridge-Tunnel Pilings on Water Column Stratification in the Lower Chesapeake Bay," \$24,875, Sverdrup Corporation.

A. D. KIRWAN, ``Nonlinear Secondary Oceanic Flows: Their Role in the Transport of Mass Momentum and Energy," \$39,075, Office of Naval Research.

E. E. HOFMANN and J. M. KLINCK, ``Long-term Ecological Research on the Antarctic Marine Ecosystem: An Ice-dominated Environment," \$64,069, University of California.

E. E. HOFMANN and J. M. KLINCK, ``Coupled Oyster-by-Hydrodynamic Model for Galveston Bay and the Galveston by Ship Channel Project," \$23,314, Texas A&M Research Foundation.

J. L. MILLER, ``Planning Visit for Development of a Brazil Current--Continental Shelf Interaction Study," \$4,001, National Science Foundation.

E. A. SMITH, ``AVHRR Pathfinder Ocean Data Validation," \$25,000, Jet Propulsion Laboratory, California Institute of Technology.

G. H. WHELESS and L. P. ATKINSON, ``Along shore Transport and Larval Recruitment (SABRE-2)," \$16,455, Virginia Graduate Marine Science Consortium.

Publications

M. M. DEKSHENIEKS, E. E. HOFMANN, and E. N. Powell, ``Environmental Effects on the Growth and Development of Eastern Oyster, *Crassostrea virginica* (Gmelin, 1791) Larvae: A Modeling Study," *J. Shellfish Res.*, 12(2), December 1993.

J. M. MILLER, ``Fluctuations of Gulf Stream Frontal Position Between Cape Hatteras and the Straits of Florida," *J. Geophys. Res.*, 99(C3), 5,057-5,064, March 15, 1994.

A. VALLE-LEVINSON and R. E. Wilson, ``Effects of Sill Bathymetry, Oscillating Barotropic Forcing and Vertical Mixing on Estuary/Ocean Exchange," *J. Geophys. Res.*, 99(C3), 5,149-5,169, March 15, 1994.

Presentations

M. M. DEKSHENIEKS, E. E. Hofmann, J. M. Klinck, and E. N. Powell, of Texas A&M University, ``Factors Determining Recruitment Success of *Crassostrea virginica* in a Temperature Latitude Estuary: A Modeling Study." National Shellfisheries Meeting, Charleston, South Carolina, April 24-28, 1994.

E. E. HOFMANN, J. M. Klinck, and E. N. Powell of Texas A&M University, ``*Perkinus Marinus* and Oyster Populations: Modeling the Disease," National Shellfisheries Meeting, Charleston, South Carolina, April 24-28, 1994.

A. D. KIRWAN, JR., ``Quasigeostrophic Multipole Vortices," Department of Mathematics, University of Stuttgart, Germany, May 3, 1994.

J. M. KLINCK, ``Modeling Drake Passage Transports," IAPSO Workshop on Interbasin Exchanges in the Southern Hemisphere, Cape Town, South Africa, March 28-31, 1994.

L. M. LAWSON, Y. H. Spitz, and E. E. Hofmann, ``Data Assimilation Using the Variational Method in A Marine Ecosystem Model," Society for Industrial and Applied Mathematics, Southeast Area Section (SIAM-SEAS), Wake Forest University, Winston Salem, North Carolina, March 25-26, 1994.

Papers presented by CCPO faculty, researchers, and students at the 1994 Ocean Sciences Meeting, sponsored by ASLO and AGU, held in San Diego, California, during the week of February 21-25, 1994.

L. P. ATKINSON, ``Low Salinity Water into the North Atlantic--Summer/Fall 1993."

P. BECKER and G. Bjork of University of Goteborg, Sweden, ``Residence Times in the Upper Arctic Ocean."

M. M. DEKSHENIEKS, E. E. Hofmann, J. M. Klinck, and E. N. Powell of Texas A&M University, ``A Model of the Growth, Behavior and Vertical Distribution of Oyster Larvae."

E. E. HOFMANN, D. A. Smith, B. L. Lipphardt, Jr., J. M. Klinck, and R. A. Locarnini of Texas A&M University, ``Circulation and Heat Distributions on the Continental Shelf West of the Antarctic Peninsula."

J. J. HOLDZKOM II, A. D. Kirwan, Jr., C. E. Grosch, and M. Zubair and N. Kausar, both of the Computer Science Department of Old Dominion University, ``Particle in Cell Simulations of Coastal Flows Using Massively Parallel Computers: Progress Report."

A. D. KIRWAN, JR., B. L. Lipphardt, Jr., and R. P. Mied of Naval Research Laboratory, Washington, DC, ``Multipole Vortices in the Gulf of Mexico."

J. M. KLINCK, ``Model Study of Effects of Along shore Flow on Circulation in Submarine Canyons."

J. E. KROLL, ``The Chaotic Evolution of a Baroclinic Instability."

C. LASCARA, E. E. Hofmann, and R. M. Ross and L. B. Quetin, both of Marine Science Institute, University of California, Santa Barbara, ``Seasonal Changes in the Mesoscale Distribution of Antarctic Krill in the Waters West of the Antarctic Peninsula."

L. LAWSON, Y. H. Spitz, and E. E. Hofmann, ``Data Assimilation Techniques Applied to A Marine Ecosystem Model." B. L. LIPPHARDT, JR., A. D. Kirwan, Jr., and R. R. Mied of Naval Research Laboratory, Washington, DC, ``Kinematics of Dipoles from a Baroclinic Modon Solution."

J. L. MILLER, ``Interactions Between Coastal and Estuarine Waters at Chesapeake Bay Mouth." J. L. MILLER, and M. da Silva and E. Campos, both of Sao Paulo, Brazil, ``Water Mass Characteristics Observed During Project COROAS."

C. P. MULLEN and A. D. Kirwan, Jr., ``Kinematics of the Gulf Stream Composite Imagery and Satellite-tracked Drifters."

D. A. SMITH, E. E. Hofmann, J. M. Klinck, R. A. Locarnini of Texas A&M University, and R. Smith of the Center for Remote Sensing and Environmental Optics, University of California, Santa Barbara, ``Palmer LTER: Water Mass Distribution West of the Antarctic Peninsula."

E. A. SMITH and M. K. Hamilton, A. V. Tran, and J. Vazquez, all three of Atmospheric and Oceanography Sciences Section, Jet Propulsion Laboratory. ``Quality Assurance and Distribution of Sea Surface Temperature Data from the NASA/NOAA AVHRR Ocean Pathfinder Project."

Y. H. SPITZ and J. M. Klinck, ``Recovery of Circulation and Forcing in an Enclosed Basin by Assimilation of Tide Gauge Observations."

A. VALLE-LEVINSON and J. M. Klinck, ``Baroclinic Exchange in the Lower Chesapeake Bay."

G. H. WHELESS, ``Effects of Variable Wind Stress on the Behavior of a Buoyant Estuarine Plume."

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* Special recognition goes to John Holdzkom II for the title, *CCPO Circulation*.

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